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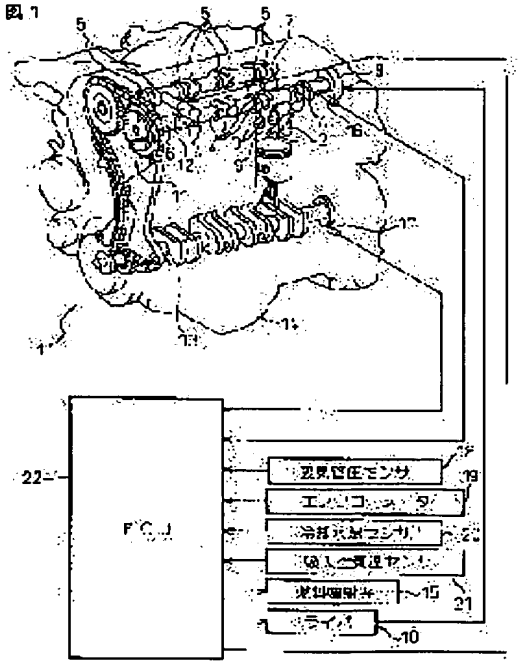
(54) INTAKE AIR AMOUNT OPERATING DEVICE FOR INTERNAL COMBUSTION ENGINE

(57)Abstract:
PROBLEM TO BE SOLVED: To accurately calculate an intake air amount to be sucked in a cylinder even when an opening area of an intake valve is changed or when an operating angle of the intake valve is changed.
SOLUTION: A valve lifting amount changing device 9 is provided for changing a valve lifting amount of the intake valve 2 and changing the operating angle of the intake valve 2, and the amount of the intake air sucked in the cylinder is calculated on the basis of the opening area of the intake valve and the operating angle of the intake valve changed by the valve lifting amount changing device 9.



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CLAIMS

[Claim(s)]
[Claim 1] The inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the opening area of the inlet valve you are made to change by the good fluctuation valve system in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content which possesses a good fluctuation valve system and is inhaled in a gas column.
[Claim 2] The inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the working angle of the inlet valve you are made to change by the good fluctuation valve system in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content which possesses a good fluctuation valve system and is inhaled in a gas column.
[Claim 3] The inhalation air content arithmetic unit of the internal combustion engine according to claim 1 or 2 characterized by computing a charging efficiency based on the opening area of an inlet valve, the working angle of an inlet valve, the phase of an inlet valve, and the pressure within inhalation of air, and computing an inhalation air content based on a charging efficiency and the pressure within inhalation of air.
[Claim 4] The inhalation air content arithmetic unit of the internal combustion engine according to claim 1 or 2 characterized by computing an inhalation air content based on the cylinder internal pressure which the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air was brought forward, and was presumed from the pressure within inhalation of air, so that the opening area of an inlet valve is made to decrease by the good fluctuation valve system, when presuming cylinder internal pressure based on the pressure within [in predetermined timing] inhalation of air.
[Claim 5] The inhalation air content arithmetic unit of the internal combustion engine according to claim 4 characterized by making the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed.
[Claim 6] The inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by computing an inhalation air content based on the pressure and cylinder internal pressure within inhalation of air.
[Claim 7] The inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by computing the opening area of the inlet valve you are made to change by the good fluctuation valve system with a predetermined time interval during an inhalation-of-air valve-opening valve period, and computing an inhalation air content based on the opening area of the inlet valve for every predetermined time interval of the.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to an internal combustion engine's inhalation air content arithmetic unit.
[0002]
[Description of the Prior Art] Conventionally, a good fluctuation valve system is provided and the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content inhaled in a gas column is known. As an example of this kind of internal combustion engine's inhalation air content arithmetic unit, there are some which were indicated by JP,7-301144,A, for example. In an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A, the good fluctuation valve system to which the closing motion timing of an inlet valve is shifted is prepared without changing the valve-opening period of an inlet valve, and the inhalation air content is computed based on the shift amount of modification of the closing motion timing of an inlet valve, i.e., the amount of the rotation phase (henceforth "the phase of an inlet valve") of the cam shaft for an inlet-valve drive to a crankshaft. Consequently, the inhalation air content is computed more correctly than the case where the shift amount of the closing motion timing of an inlet valve is not taken into consideration.
[0003]
[Problem(s) to be Solved by the Invention] However, in an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A, although the shift amount of the closing motion timing of an inlet valve is taken into consideration when computing the inhalation air content inhaled in a gas column, the amount of modification of the opening area of an inlet valve is not taken into consideration. On the other hand, the function to change the amount of valve lifts into a good fluctuation valve system is prepared, and when the opening area of an inlet valve is made to change by changing the amount of valve lifts, even if the closing motion timing of an inlet valve is not shifted, the inhalation air content actually inhaled in a gas column is changed considerably. Therefore, if an inhalation air content is computed without taking into consideration modification of the opening area of an inlet valve with an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A when the opening area of an inlet valve is made to change, the computed inhalation air content and an actual inhalation air content will be considerably different. That is, in an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A, when the opening area of an inlet valve is made to change, the inhalation air content inhaled in a gas column cannot be computed correctly.
[0004] Moreover, in an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A, although the shift amount of the closing motion timing of an inlet valve is taken into consideration when computing the inhalation air content inhaled in a gas column, the amount of modification of the working angle of an inlet valve of modification, i.e., the amount of the angle of rotation of the cam shaft equivalent to the valve-opening period of an inlet valve, is not taken into consideration. On the other hand, when the function, i.e., the function to make the valve-opening period of an inlet valve fluctuate, to change the working angle of an inlet valve into a good fluctuation valve system is prepared and the working angle of an inlet valve is made to change, even if the closing motion timing of an inlet valve is not shifted, the inhalation air content actually inhaled in a gas column is changed considerably. Therefore, if an inhalation air content is computed without taking into consideration modification of the working angle of an inlet valve with an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A when the working angle of an inlet valve is made to change, the computed inhalation air content and an actual inhalation air content will be considerably different. That is, in an internal combustion engine's

inhalation air content arithmetic unit indicated by JP,7-301144,A, when the working angle of an inlet valve is made to change, the inhalation air content inhaled in a gas column cannot be computed correctly.
[0005] Even if it is the case where the opening area of an inlet valve is made to change this invention in view of said trouble, it aims at offering the inhalation air content arithmetic unit of the internal combustion engine which can compute correctly the inhalation air content inhaled in a gas column.
[0006] Furthermore, even if this invention is the case where the working angle of an inlet valve is made to change, it aims at offering the inhalation air content arithmetic unit of the internal combustion engine which can compute correctly the inhalation air content inhaled in a gas column.
[0007]
[Means for Solving the Problem] According to invention according to claim 1, a good fluctuation valve system is provided and the inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the opening area of the inlet valve you are made to change by the good fluctuation valve system is offered in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content inhaled in a gas column.
[0008] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 1, since an inhalation air content is computed based on the opening area of the inlet valve you are made to change by the good fluctuation valve system, the function to change the amount of valve lifts into a good fluctuation valve system is prepared, and even if it is the case where the opening area of an inlet valve is made to change by changing the amount of valve lifts, the inhalation air content inhaled in a gas column is correctly computable.
[0009] According to invention according to claim 2, a good fluctuation valve system is provided and the inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the working angle of the inlet valve you are made to change by the good fluctuation valve system is offered in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content inhaled in a gas column.
[0010] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 2 Since an inhalation air content is computed based on the working angle of the inlet valve you are made to change by the good fluctuation valve system, i.e., the angle of rotation of the cam shaft equivalent to the valve-opening period of an inlet valve, For example, the function to change the working angle of an inlet valve into a good fluctuation valve system is prepared, and even if it is the case where the working angle of an inlet valve is made to change by the good fluctuation valve system, the inhalation air content inhaled in a gas column is correctly computable.
[0011] According to invention according to claim 3, the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 or 2 characterized by computing a charging efficiency based on the opening area of an inlet valve, the working angle of an inlet valve, the phase of an inlet valve, and the pressure within inhalation of air, and computing an inhalation air content based on a charging efficiency and the pressure within inhalation of air is offered.
[0012] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 3 Since a charging efficiency is computed based on the opening area of an inlet valve, the working angle of an inlet valve, the phase of an inlet valve, and the pressure within inhalation of air and an inhalation air content is computed based on a charging efficiency and the pressure within inhalation of air, The inhalation air content inhaled in a gas column compared with the case where an inhalation air content is computed, from the charging efficiency computed without being based on the opening area of an inlet valve and the working angle of an inlet valve is correctly computable.
[0013] When cylinder internal pressure is presumed based on the pressure within [in predetermined timing] inhalation of air according to invention according to claim 4, The detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air is brought forward, so that the opening area of an inlet valve is made to decrease by the good fluctuation valve system. The inhalation air content arithmetic unit of the internal combustion engine according to claim 1 or 2 characterized by computing an inhalation air content based on the cylinder internal pressure presumed from the pressure within inhalation of air is offered.
[0014] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 4 An example is taken by the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becoming large as the opening area of an inlet valve is made to decrease. When presuming cylinder internal pressure based on the pressure within [in predetermined timing] inhalation of air The detection timing of the pressure within [which is used in order to presume cylinder internal pressure]

inhalation of air is brought forward, and an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within inhalation of air, so that the opening area of an inlet valve is made to decrease by the good fluctuation valve system. Therefore, the pressure within inhalation of air can be uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the opening area of an inlet valve is made to decrease, and the inhalation air content inhaled in a gas column can be correctly computed compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air.

[0015] According to invention according to claim 5, the inhalation air content arithmetic unit of the internal combustion engine according to claim 4 characterized by making the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed is offered.

[0016] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 5 If at least one of the working angle of an inlet valve and the phase of an inlet valve, i.e., the rotation phase of the cam shaft for an inlet-valve drive to a crankshaft, the pressure within inhalation of air, and engine rotational frequencies is changed An example is taken by the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changing with the modification. The detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air is made to change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed. Therefore, if at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changes with the modification, the inhalation air content inhaled in a gas column is correctly computable.

[0017] According to invention according to claim 6, the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by computing an inhalation air content based on the pressure and cylinder internal pressure within inhalation of air is offered.

[0018] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 6, since an inhalation air content is computed also based on the pressure and cylinder internal pressure within inhalation of air in addition to the opening area of the inlet valve you are made to change by the good fluctuation valve system, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration the pressure and cylinder internal pressure within inhalation of air.

[0019] According to invention according to claim 7, the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by computing the opening area of the inlet valve you are made to change by the good fluctuation valve system with a predetermined time interval during an inhalation-of-air valve-opening valve period, and computing an inhalation air content based on the opening area of the inlet valve for every predetermined time interval of the is offered.

[0020] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 7, in view of the inhalation air content inhaled by per unit time amount in a gas column changing, the opening area of the inlet valve you are made to change by the good fluctuation valve system is computed with a predetermined time interval during an inhalation-of-air valve-opening valve period, and an inhalation air content is computed based on the opening area of the inlet valve for every predetermined time interval of the. Therefore, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration that the inhalation air content inhaled by per unit time amount in a gas column is changing.

[0021]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained using an accompanying drawing.

[0022] Drawing 1 is the outline block diagram of the first operation gestalt of the inhalation air content arithmetic unit of the internal combustion engine of this invention. In drawing 1 , a cam for a cam for an inlet valve and 3 to open and close an exhaust valve, and for an internal combustion engine and 2 make an inlet valve, as for 4, opening and closing [1] and 5 to make an exhaust valve opening and closing, the cam shaft with which 6 is supporting the cam 4 for inlet valves, and 7 are cam shafts which are supporting the

cam 5 for exhaust valves. Drawing 2 is the detail drawing of the cam for inlet valves shown in drawing 1 , and a cam shaft. As shown in drawing 2 , the cam profile of the cam 4 of this operation gestalt is changing in the direction of a cam-shaft medial-axis line. that is, the cam 4 of this operation gestalt -- the nose at the left end of drawing 2 R> 2 -- height -- a right end nose -- it is larger than height. Namely, as for the amount of valve lifts of the inlet valve 2 of this operation gestalt, the direction when the valve lifter is in contact with the right end of a cam 4 becomes small rather than the time of the valve lifter being in contact with the left end of a cam 4.

[0023] It is the amount modification equipment of valve lifts for making explanation of drawing 1 move a cam 4 in the direction of a cam-shaft medial-axis line to an inlet valve 2, in order that return, the combustion chamber where 8 was formed in the gas column, and 9 may change the amount of valve lifts. That is, by operating the amount modification equipment 9 of valve lifts, in the left end (drawing 2) of a cam 4, a cam 4 and a valve lifter can be contacted or a cam 4 and a valve lifter can be contacted in the right end (drawing 2) of a cam 4. When the amount of valve lifts of an inlet valve 2 is changed by the amount modification equipment 9 of valve lifts, the opening area of an inlet valve 2 will be changed in connection with it. In the inlet valve 2 of this operation gestalt, the opening area of an inlet valve 2 increases as the amount of valve lifts is increased. A driver for 10 to drive the amount modification equipment 9 of valve lifts and 11 are the closing motion timing shifters for shifting the closing motion timing of an inlet valve, without changing the valve-opening period of an inlet valve 2. That is, by operating the closing motion timing shifter 11, the closing motion timing of an inlet valve 2 can be shifted to a tooth-lead-angle side, or can be shifted to a lag side. 12 is an oil control valve which controls the oil pressure for operating the closing motion timing shifter 11. In addition, both amount modification equipment 9 of valve lifts and closing motion timing shifter 11 will be contained in the good fluctuation valve system in this operation gestalt.

[0024] A sensor for an oil pan mechanism and 15 to detect a fuel injection valve, and for a crankshaft and 14 detect the amount of valve lifts and closing motion timing shift amount of an inlet valve 2 in 13, as for 16 and 17 are the sensors for detecting an engine rotational frequency. An inhalation sky atmospheric temperature sensor for a cooling coolant temperature sensor for a pressure-of-induction-pipe sensor for 18 to detect the pressure within [which supplies inhalation air in a gas column] inhalation of air, and 19 to detect an air flow meter, and for 20 detect the temperature of internal combustion engine cooling water, and 21 to detect the temperature in the inhalation of air within the pipe one of the inhalation air supplied in a gas column, and 22 are ECUs (electronic control).

[0025] Drawing 3 is detail drawing, such as the amount modification equipment of valve lifts shown in drawing 1 . In drawing 3 , a coil for the magnetic substance with which 30 was connected with the cam shaft 6 for inlet valves, and 31 to energize the magnetic substance 30 on left-hand side, and 32 are the compression spring for energizing the magnetic substance 30 on right-hand side. The amount which a cam 4 and a cam shaft 6 move to left-hand side increases, and the amount of valve lifts of an inlet valve 2 is made to decrease as the amount of energization to a coil 31 is increased.

[0026] Drawing 4 is drawing having shown signs that the amount of valve lifts of an inlet valve changed in connection with the amount modification equipment of valve lifts operating. The amount of valve lifts of an inlet valve 2 is made to increase as are shown in drawing 4 and the amount of energization to a coil 31 decreases (a continuous line -> broken line -> alternate long and short dash line). Moreover, it is made to also change the valve-opening period of an inlet valve 2 with this operation gestalt in connection with the amount modification equipment 9 of valve lifts operating. That is, it is made to also change the working angle of an inlet valve 2. The working angle of an inlet valve 2 is made to increase to a detail in connection with the amount of valve lifts of an inlet valve 2 being made to increase (a continuous line -> broken line -> alternate long and short dash line). Furthermore, it is made to also change the timing from which the amount of valve lifts of an inlet valve 2 serves as a peak with this operation gestalt in connection with the amount modification equipment 9 of valve lifts operating. In connection with the amount of valve lifts of an inlet valve 2 being made to increase, the timing from which the amount of valve lifts of an inlet valve 2 serves as a peak carries out a lag to a detail (a continuous line -> broken line -> alternate long and short dash line).

[0027] Drawing 5 is detail drawing, such as a closing motion timing shifter shown in <A HREF="/Tokujitu/tjitemdrw.ipdl?N0000=237&N0500=1E_N/;>;>7? 76=///&N0001=323&N0552=9&N0553=000003" TARGET="tjitemdrw"> drawing 1. In drawing 5 , a lag side cut way for a tooth-lead-angle side cut way for 40 to shift the closing motion timing of an inlet valve 2 to a tooth-lead-angle side and 41 to shift the closing motion timing of an inlet valve 2 to a lag side and 42 are oil pumps. The closing motion timing of an inlet valve 2 is made to shift to a tooth-lead-angle side as the oil pressure in the tooth-lead-angle side cut way 40 is increased. That is, the rotation phase of the cam shaft

6 to a crankshaft 13 carries out a tooth lead angle. On the other hand, the closing motion timing of an inlet valve 2 is made to shift to a lag side as the oil pressure of the lag side cut way 41 is increased. That is, the rotation phase of the cam shaft 6 to a crankshaft 13 carries out a lag.

[0028] Drawing 6 is drawing having shown signs that the closing motion timing of an inlet valve shifted in connection with a closing motion timing shifter operating. The closing motion timing of an inlet valve 2 is shifted to a tooth-lead-angle side as are shown in drawing 6 and the oil pressure in the tooth-lead-angle side cut way 40 is increased (a continuous line -> broken line -> alternate long and short dash line). At this time, the valve-opening period of an inlet valve 2 is not changed, that is, the die length of the period which the inlet valve 2 is opening is not changed.

[0029] If the amount of valve lifts of an inlet valve 2, a working angle, and closing motion timing (phase) are made to change as mentioned above by the amount modification equipment 9 of valve lifts, and the closing motion timing shifter 11, in connection with it, the inhalation air content actually inhaled in a gas column will change. Although an inhalation air content changes, if the fuel of the specified quantity is injected uniformly, an actual air-fuel ratio will shift from a target air-fuel ratio. Therefore, in order to make an actual air-fuel ratio in agreement with a target air-fuel ratio, it is necessary to compute correctly the inhalation air content which changes with modification of the amount of valve lifts of an inlet valve 2, a working angle, and closing motion timing (phase).

[0030] Drawing 7 is the flow chart which showed the calculation approach of the inhalation air content inhaled in the gas column in this operation gestalt. This routine is performed at intervals of predetermined time. If this routine is started as shown in drawing 7 , in step 100, it will be judged first whether it is at the engine starting time. At the time of YES, it judges that an inhalation air content does not need to compute correctly at the time of engine starting to which fuel increase in quantity is carried out, and this routine is ended at it. On the other hand, it progresses to step 101 at the time of NO. At step 101, the charging-efficiency reference value KTPb is computed based on the pressure PM and the engine rotational frequency NE the amount LT of valve lifts, the working angle VA, the closing motion timing VT, and within inhalation of air of an inlet valve 2.

[0031] Drawing 8 is drawing having shown the relation between the charging-efficiency reference value KTPb, the amount LT of valve lifts, and the pressure PM within inhalation of air. As shown in drawing 8 , the charging-efficiency reference value KTPb computed in step 101 becomes large as it becomes large as the amount LT of valve lifts becomes large, and the pressure PM within inhalation of air becomes high. Drawing 9 is drawing having shown the relation between the charging-efficiency reference value KTPb, the working angle VA, and the pressure PM within inhalation of air. As shown in drawing 9 , the charging-efficiency reference value KTPb computed in step 101 becomes large as the working angle VA becomes large. Drawing 10 is drawing having shown the charging-efficiency reference value KTPb, the working angle VA, and relation with the closing motion timing VT. As shown in drawing 10 , the charging-efficiency reference value KTPb computed in step 101 becomes large as the lag of the closing motion timing VT is carried out. Drawing 11 is drawing having shown the relation between the charging-efficiency reference value KTPb and the engine rotational frequency NE. As shown in drawing 11 , the charging-efficiency reference value KTPb computed in step 101 serves as a peak, when the engine rotational frequency NE is medium speed.

[0032] Subsequently to in a gas column based on return and the inhalation air content GN GN inhaled per rotation with the engine rotational frequency NE at step 102, i.e., the inhalation air content which sets like 1 time of an inhalation-of-air line, and is inhaled in a gas column, the charging-efficiency back pressure correction factor Kex is computed by explanation of drawing 7 . In addition, in this step 102, the value of the inhalation air content GN inhaled in a gas column per [which was computed in step 105 later mentioned when the routine shown in drawing 7 is performed last time] rotation is used. Drawing 12 is drawing having shown the relation between the charging-efficiency effectiveness back pressure correction factor Kex, the inhalation air content GN inhaled in a gas column per rotation, and the engine rotational frequency NE. As shown in drawing 12 , the charging-efficiency effectiveness back pressure correction factor Kex computed in step 102 becomes small as it becomes small as the inhalation air content GN inhaled in a gas column per rotation decreases, and the engine rotational frequency NE becomes high.

[0033] Subsequently to in a gas column based on the temperature (henceforth "inhalation sky atmospheric temperature") THA in the inhalation of air within the pipe one of return and the inhalation air supplied at step 103, the temperature (henceforth "cooling water temperature") THW of internal combustion engine cooling water, and the inhalation air content GA detected by the air flow meter 19, the charging-efficiency engine warming-up correction factor Kthw is computed by explanation of drawing 7 . Drawing 13 is

drawing having shown the relation between the gas temperature in a cylinder, inhalation sky atmospheric temperature THA, and the inhalation air content GA. The gas temperature in a cylinder used in order to compute the charging-efficiency engine warming-up correction factor Kthw in step 103, as shown in drawing 13 becomes high as inhalation sky atmospheric temperature THA becomes high, and it becomes low as the inhalation air content GA increases. Drawing 14 R> 4 is drawing having shown the relation between the gas temperature in a cylinder, the cooling water temperature THW, and the inhalation air content GA. The gas temperature in a cylinder used in order to compute the charging-efficiency engine warming-up correction factor Kthw in step 103, as shown in drawing 14 becomes high as the cooling water temperature THW becomes high, and it becomes low as the inhalation air content GA increases. Drawing 15 is drawing having shown the relation between the charging-efficiency engine warming-up correction factor Kthw and the gas temperature in a cylinder. As shown in drawing 15 , the charging-efficiency engine warming-up correction factor Kthw computed in step 103 becomes small as the gas temperature in a cylinder becomes high.

[0034] The charging-efficiency actual value KTP is computed by explanation of drawing 7 based on return, and the charging-efficiency back pressure correction factor Kex computed in the charging-efficiency reference value KTPb and step 102 which were computed [in / subsequently / at step 104 / step 101] and the charging-efficiency engine warming-up correction factor Kthw computed in step 103 (KTP<-KTPbxKexxKthw). Subsequently, at step 105, the inhalation air content GN inhaled in a gas column per rotation based on the charging-efficiency actual value KTP computed in step 104 and the pressure PM within inhalation of air is computed (GN<-KTPxPM).

[0035] As mentioned above, with this operation gestalt, the inhalation air content (inhalation air content GN inhaled in a gas column per rotation) inhaled in a gas column is computed in step 101, step 104, and step 105 of drawing 7 based on the opening area of the inlet valve 2 you are made to change in connection with the amount LT of valve lifts being changed by the amount modification equipment 9 of valve lifts as a good fluctuation valve system. Therefore, according to this operation gestalt, even if it is the case where the opening area of an inlet valve is made to change by changing the amount of valve lifts unlike the case of an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A mentioned above, the inhalation air content inhaled in a gas column is correctly computable.

[0036] Furthermore, with this operation gestalt, the inhalation air content (inhalation air content GN inhaled in a gas column per rotation) inhaled in a gas column is computed in step 101, step 104, and step 105 of drawing 7 based on the working angle VA of the inlet valve 2 you are made to change in connection with the amount of valve lifts being changed with the amount modification equipment 9 of valve lifts as a good fluctuation valve system. Therefore, according to this operation gestalt, even if it is the case where the working angle of an inlet valve 2 is made to change unlike the case of an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A mentioned above, the inhalation air content inhaled in a gas column is correctly computable.

[0037] Moreover, the opening area of the inlet valve 2 you are made to change in step 101 of drawing 7 with this operation gestalt in connection with the amount LT of valve lifts being changed by the amount modification equipment 9 of valve lifts as a good fluctuation valve system, The phase of the inlet valve 2 you are made to change by the working angle VA and the closing motion timing shifter 11 of an inlet valve 2 (closing motion timing VT), And based on the pressure PM within inhalation of air, a charging efficiency (charging-efficiency reference value KTPb) is computed, and it sets to step 105. The inhalation air content (inhalation air content GN inhaled in a gas column per rotation) inhaled in a gas column based on a charging efficiency (charging-efficiency actual value KTP) and the pressure PM within inhalation of air is computed. Therefore, according to this operation gestalt, the inhalation air content inhaled in a gas column compared with the case where an inhalation air content is computed, from the charging efficiency computed without being based on the opening area of an inlet valve and the working angle of an inlet valve is correctly computable.

[0038] In addition, although the pressure PM within inhalation of air is computed based on the output value of the pressure-of-induction-pipe sensor 18 with this operation gestalt, it is also possible to compute the pressure PM within inhalation of air instead in the modification of this operation gestalt based on the inhalation air content GA detected by the air flow meter 19, the engine rotational frequency NE, etc.

[0039] Hereafter, the second operation gestalt of the inhalation air content arithmetic unit of the internal combustion engine of this invention is explained. The configuration of this operation gestalt is the same as the configuration of the first operation gestalt shown in drawing 1 - drawing 6 almost. Although the inhalation air content inhaled in a gas column is computed with the operation gestalt mentioned above based

on the charging efficiency and the pressure within inhalation of air, with this operation gestalt, cylinder internal pressure is computed based on the pressure within inhalation of air, etc. and the following formula, and the inhalation air content inhaled in a gas column based on the cylinder internal pressure etc. and the following formula is computed.

[0040]

pC=kRTImC/VC-kPCvC/VC (1)

mC=AV(k+1) (PIrhoI/2k) 1/2- (k/(k+1)) (2-(PC/PI-1/(k+1)) 2) 1/2 (2)

Here, the inhalation air contents and VC by which the ratio of specific beat and TI are inhaled by gas ** within inhalation of air in an instant, and mC is inhaled [pC] for instant cylinder internal pressure and k in a gas column are the volume in a gas column, and the volume in the gas column of an instant [PC / vC / cylinder internal pressure and]. Moreover, AV is [the pressure within inhalation of air and rhoI of the opening area of an inlet valve and PI] consistencies.

[0041] With this operation gestalt, the inhalation air content (inhalation air content mC inhaled in a gas column in an instant) inhaled in a gas column is computed based on the opening area AV of the inlet valve you are made to change in connection with the amount LT of valve lifts being changed with the amount modification equipment 9 of valve lifts as a good fluctuation valve system. Therefore, according to this operation gestalt, even if it is the case where the opening area of an inlet valve is made to change by changing the amount of valve lifts unlike the case of an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A mentioned above, the inhalation air content inhaled in a gas column is correctly computable.

[0042] Drawing 16 is drawing having shown the detection stage of the amount of valve lifts of an inlet valve, and the pressure within inhalation of air etc. As shown in drawing 16 , with this operation gestalt, the amount of valve lifts of an inlet valve is set as a comparatively large value by the amount modification equipment 9 of valve lifts (continuous line). When the opening area of an inlet valve is set as the comparatively large value in connection with it The pressure within inhalation of air is detected when clausilium actuation of an inlet valve is completed (A1). Cylinder internal pressure is presumed based on the pressure within [at the time] inhalation of air, an inhalation air content is computed based on the cylinder internal pressure, subsequently fuel oil consumption is determined based on the inhalation air content, and (A4) and fuel injection are performed (A5). On the other hand, the amount of valve lifts of an inlet valve is set as a comparatively small value by the amount modification equipment 9 of valve lifts (broken line). When the opening area of an inlet valve is set as the comparatively small value in connection with it An example is taken by the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becoming large as the opening area of an inlet valve is made to decrease. The time of clausilium actuation of an inlet valve being completed, the pressure within inhalation of air is detected, when earlier than (A3) (A2). Cylinder internal pressure is presumed based on the pressure within [at the time] inhalation of air, an inhalation air content is computed based on the cylinder internal pressure, subsequently fuel oil consumption is determined based on the inhalation air content, and (A4) and fuel injection are performed (A5).

[0043] That is, with this operation gestalt, when presuming cylinder internal pressure based on the pressure within [in predetermined timing (A1 A2)] inhalation of air So that the opening area of an inlet valve is made to decrease in connection with the amount of valve lifts of an inlet valve being made to decrease with the amount modification equipment 9 of valve lifts as a good fluctuation valve system The detection timing of the pressure within [which is used for presuming cylinder internal pressure] inhalation of air is brought forward (A1 ->A2), and an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within inhalation of air. Therefore, according to this operation gestalt, the pressure within inhalation of air is uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the opening area of an inlet valve is made to decrease. Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air, the inhalation air content inhaled in a gas column is correctly computable.

[0044] As similarly shown in drawing 16 , when presuming cylinder internal pressure based on the pressure within [in predetermined timing (A1 A2)] inhalation of air [that the working angle of an inlet valve is made to decrease with the amount modification equipment 9 of valve lifts as a good fluctuation valve system (continuous line -> broken line), and] The detection timing of the pressure within [which is used for presuming cylinder internal pressure] inhalation of air is brought forward (A1 ->A2), and an inhalation air

content is computed based on the cylinder internal pressure presumed from the pressure within inhalation of air. Therefore, according to this operation gestalt, the pressure within inhalation of air is uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the working angle of an inlet valve is made to decrease. Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air, the inhalation air content inhaled in a gas column is correctly computable.

[0045] Drawing 17 is drawing having shown the relation between the detection timing of the pressure within inhalation of air, the phase (closing motion timing) of an inlet valve, and the pressure within inhalation of air. If the phase of an inlet valve (closing motion timing), i.e., the rotation phase of the cam shaft 6 for an inlet-valve drive to a crankshaft 13, and the pressure within inhalation of air are changed with this operation gestalt as shown in drawing 17 In view of the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changing with the modification, the detection timing of the pressure within inhalation of air is brought forward as the lag of the phase (closing motion timing) of an inlet valve is carried out, and it is brought forward as the pressure within inhalation of air becomes high.

[0046] Drawing 18 is drawing having shown the relation between the detection timing of the pressure within inhalation of air, the phase (closing motion timing) of an inlet valve, and an engine rotational frequency. As shown in drawing 18 , also when an engine rotational frequency is changed, with this operation gestalt, the detection timing of the pressure within inhalation of air is brought forward in view of the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changing with the modification as an engine rotational frequency becomes high.

[0047] Namely, with this operation gestalt, if at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed In view of the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changing also with the modification, as shown in drawing 16 - drawing 18 The detection timing of the pressure within [which is used for presuming cylinder internal pressure] inhalation of air is made to change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed. Therefore, if at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed according to this operation gestalt Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changes with the modification, the inhalation air content inhaled in a gas column is correctly computable.

[0048] Hereafter, the third operation gestalt of the inhalation air content arithmetic unit of the internal combustion engine of this invention is explained. The configuration of this operation gestalt is the same as the configuration of the first operation gestalt shown in drawing 1 - drawing 6 almost. Drawing 19 is the flow chart which showed the calculation approach of the inhalation air content inhaled in the gas column in this operation gestalt. This routine is performed for every intake stroke of an internal combustion engine. If this routine is started as shown in drawing 19 , in step 200, it will be judged first whether it is at the engine starting time. At the time of YES, it judges that an inhalation air content does not need to compute correctly at the time of engine starting to which fuel increase in quantity is carried out, and this routine is ended at it. On the other hand, it progresses to step 201 at the time of NO. At step 201, the cylinder internal pressure at the initiation time is computed for an inhalation-of-air line based on back pressure. Since the close by-pass bulb completely of the inlet valve is carried out at the initiation time and the exhaust valve is opened, specifically, an inhalation-of-air line is presumed that back pressure and cylinder internal pressure are equal. Drawing 20 is drawing having shown the relation of the inhalation air content per rotation and engine rotational frequency which were computed when the routine shown in back pressure and drawing 19 was performed last time. As shown in drawing 20 , back pressure becomes high as it becomes high as the inhalation air content per last rotation decreases, and an engine rotational frequency becomes high.

[0049] It returns to explanation of drawing 19 and, subsequently the pressure within inhalation of air is computed based on the output value of the pressure-of-induction-pipe sensor 18 at step 202. It is also possible to compute the pressure within inhalation of air in the modification of this operation gestalt from the inhalation air content GA instead detected by the air flow meter 19. Subsequently, at step 203, when the cylinder internal pressure computed in step 201 or step 208 mentioned later is performed last time, the cylinder internal pressure computed in this step 208 is read. Subsequently, in step 204, a piston location is

computed based on the output value of a sensor 17, and piston speed is similarly computed based on the output value of a sensor 17 at step 205.
[0050] Subsequently, at step 206, inhalation-of-air valve-opening opening area is computed based on a flow coefficient, the amount of valve lifts of an inlet valve, and mechanical inhalation-of-air valve-opening opening area, i.e., the opening area of the valve-seat section of an inlet valve, and the flow coefficient correction value for amending the flow coefficient (inhalation-of-air valve-opening opening area <- mechanical inhalation-of-air valve-opening opening area x flow coefficient x flow coefficient correction value). Drawing 21 is drawing having shown the relation between the product of mechanical inhalation-of-air valve-opening opening area and a coefficient of discharge, and the amount of valve lifts of an inlet valve. As shown in drawing 21 , the product of mechanical inhalation-of-air valve-opening opening area and a coefficient of discharge becomes large as the amount of valve lifts of an inlet valve becomes large. Drawing 22 R> 2 is drawing having shown the relation between flow coefficient correction value, an engine rotational frequency, and the flow rate of inhalation air. As shown in drawing 22 , flow coefficient correction value becomes small as an engine rotational frequency becomes high, and it becomes small as the flow rate of inhalation air increases.
[0051] It returns to explanation of drawing 19 . Subsequently at step 207 The pressure within [which was computed in step 202] inhalation of air, i.e., the pressure of the upstream of an inlet valve, The cylinder internal pressure read in step 203, i.e., the pressure of the downstream of an inlet valve, The piston location computed in step 204, the piston speed computed in step 205, and the inhalation air content inhaled in a gas column in an instant based on the formula (2) mentioned above are computed. Subsequently, at step 208, cylinder internal pressure is computed based on the formula (1) mentioned above. Although cylinder internal pressure is computed based on the formula (1) mentioned above in step 208 with this operation gestalt, it is also possible to arrange a cylinder internal pressure sensor in a gas column, and to compute cylinder internal pressure instead, in the modification of this operation gestalt, based on the output value.
[0052] Return and the instant inhalation air content computed [in / subsequently / at step 209 / step 207] are amended by explanation of drawing 19 based on the air leak correction value in consideration of the air content which leaks from a gas column (instant inhalation air content <- instant inhalation air content x air leak correction value). Drawing 23 is drawing having shown the relation between air leak correction value, an engine rotational frequency, and the flow rate of inhalation air. As shown in drawing 23 , air leak correction value becomes large as an engine rotational frequency becomes high, and it becomes small as the flow rate of inhalation air increases.
[0053] Return and the instant inhalation air content amended [in / subsequently / at step 210 / step 209] are integrated by explanation of drawing 19 . Subsequently, at step 211, it is judged whether it ended like the inhalation-of-air line. At the time of YES, this routine is ended and the value of the inhalation air content integrated in step 210 turns into a value of the inhalation air content which sets like this inhalation-of-air line, and is inhaled in a gas column. On the other hand, at the time of NO, return and the step mentioned above are repeated to step 202.
[0054] As mentioned above, with this operation gestalt, the inhalation air content (inhalation air content inhaled in a gas column in an instant) inhaled in a gas column is computed based on the formula (2) mentioned above in step 207. That is, the inhalation air content (inhalation air content inhaled in a gas column in an instant) inhaled in a gas column is computed based on the opening area AV of the inlet valve you are made to change in connection with the amount LT of valve lifts being changed with the amount modification equipment 9 of valve lifts as a good fluctuation valve system. Therefore, according to this operation gestalt, even if it is the case where the opening area of an inlet valve is made to change by changing the amount of valve lifts unlike the case of an internal combustion engine's inhalation air content arithmetic unit indicated by JP,7-301144,A mentioned above, the inhalation air content inhaled in a gas column is correctly computable.
[0055] Moreover, in addition to the opening area AV of the inlet valve you are made to change in connection with the amount LT of valve lifts being changed by the amount modification equipment 9 of valve lifts as a good fluctuation valve system, with this operation gestalt, an inhalation air content (inhalation air content inhaled in a gas column in an instant) is computed in step 207 also based on the pressure and cylinder internal pressure within inhalation of air. Therefore, according to this operation gestalt, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration the pressure and cylinder internal pressure within inhalation of air.
[0056] Furthermore, with this operation gestalt, the opening area of the inlet valve you are made to change

with the amount modification equipment 9 of valve lifts as a good fluctuation valve system is computed with a predetermined time interval during an inhalation-of-air valve-opening valve period in view of the inhalation air content inhaled by per unit time amount in a gas column changing. That is, whenever step 210 is repeatedly performed from step 202 and step 206 is performed, the opening area of an inlet valve is computed. Subsequently, in step 207, an inhalation air content is computed based on the opening area of the inlet valve for every predetermined time interval of the. Therefore, according to this operation gestalt, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration that the inhalation air content inhaled by per unit time amount in a gas column is changing.

[0057]

[Effect of the Invention] According to invention according to claim 1, the function to change the amount of valve lifts into a good fluctuation valve system, for example is prepared, and even if it is the case where the opening area of an inlet valve is made to change by changing the amount of valve lifts, the inhalation air content inhaled in a gas column is correctly computable.

[0058] According to invention according to claim 2, the function to change the working angle of an inlet valve into a good fluctuation valve system, for example is prepared, and even if it is the case where the working angle of an inlet valve is made to change by the good fluctuation valve system, the inhalation air content inhaled in a gas column is correctly computable.

[0059] According to invention according to claim 3, the inhalation air content inhaled in a gas column compared with the case where an inhalation air content is computed, from the charging efficiency computed without being based on the opening area of an inlet valve and the working angle of an inlet valve is correctly computable.

[0060] According to invention according to claim 4, the pressure within inhalation of air is uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the opening area of an inlet valve is made to decrease. Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air, the inhalation air content inhaled in a gas column is correctly computable.

[0061] If at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed according to invention according to claim 5 Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changes with the modification, the inhalation air content inhaled in a gas column is correctly computable.

[0062] According to invention according to claim 6, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration the pressure and cylinder internal pressure within inhalation of air.

[0063] According to invention according to claim 7, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration that the inhalation air content inhaled by per unit time amount in a gas column is changing.

[Translation done.]

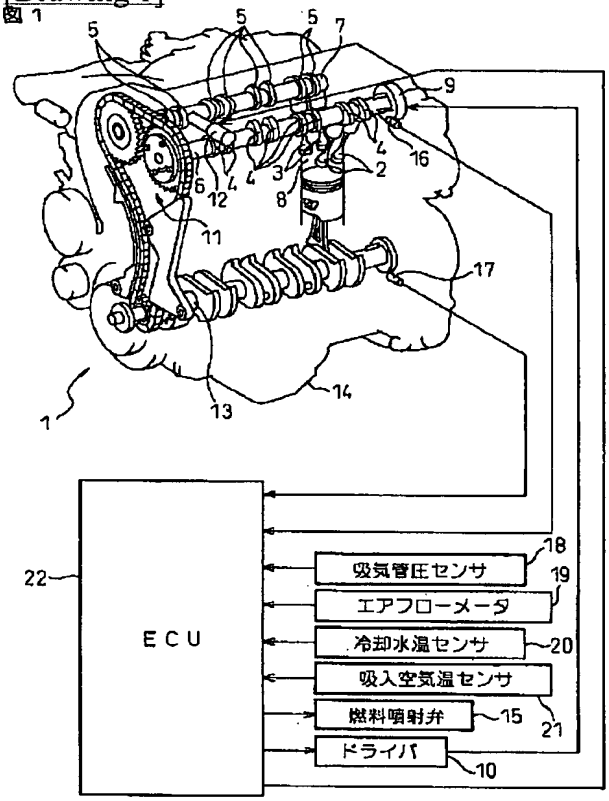
* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

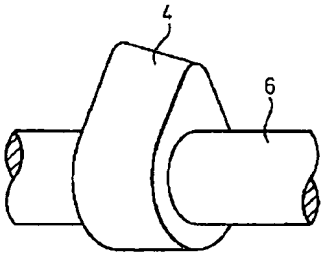
[Drawing 1]

図 1



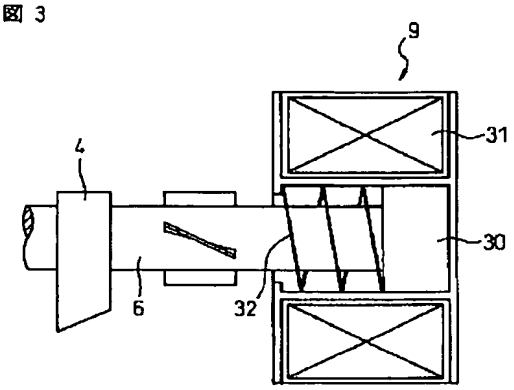
[Drawing 2]

図 2



[Drawing 3]

図 3



[Drawing 4]

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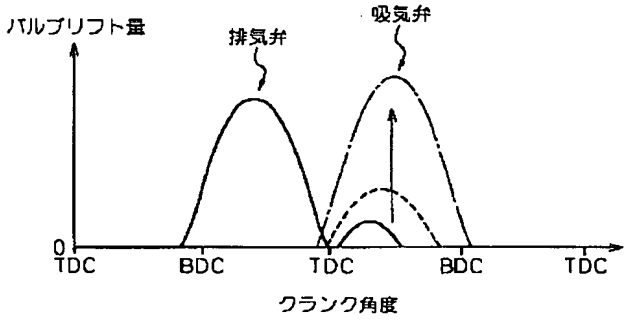

[Drawing 6]

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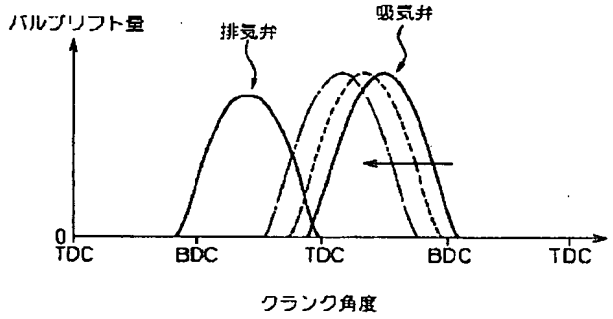

[Drawing 11]

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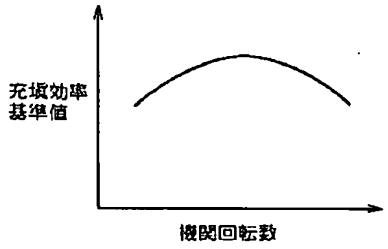

[Drawing 15]

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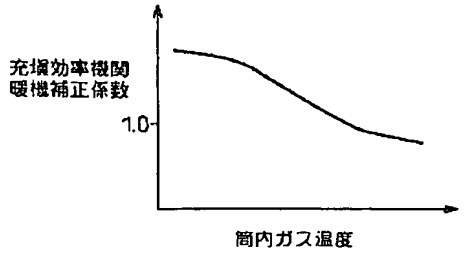
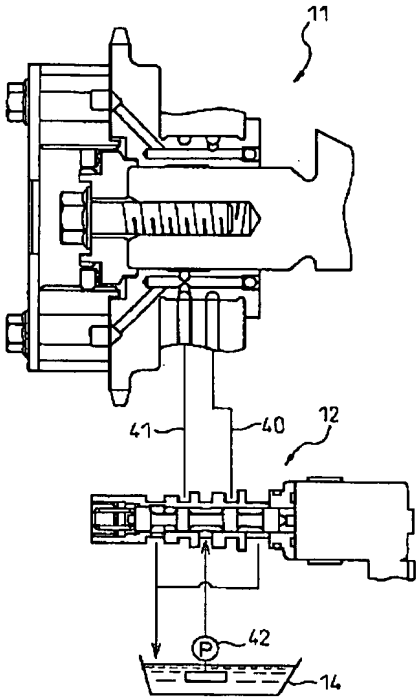


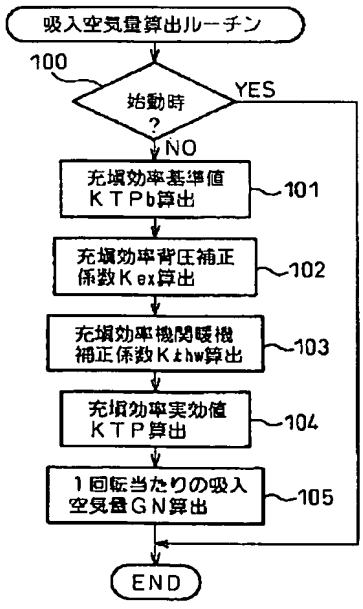
[Drawing 5]

図 5



[Drawing 7]

図 7



[Drawing 8]

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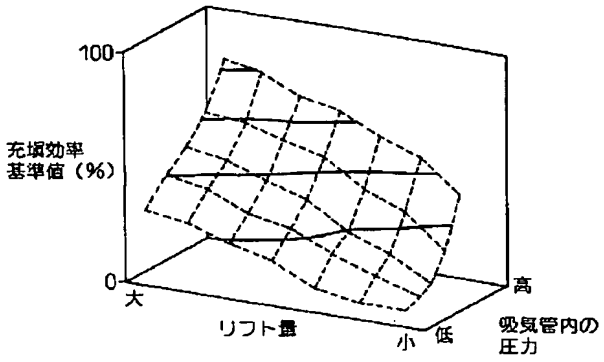

[Drawing 9]

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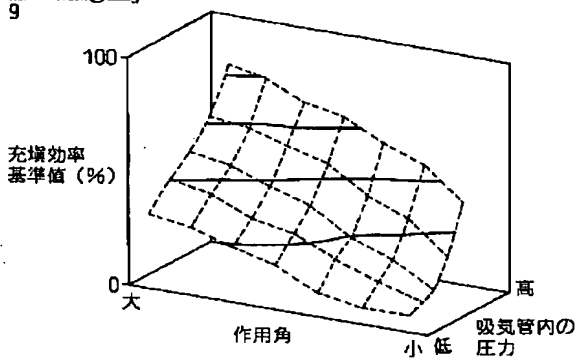

[Drawing 10]

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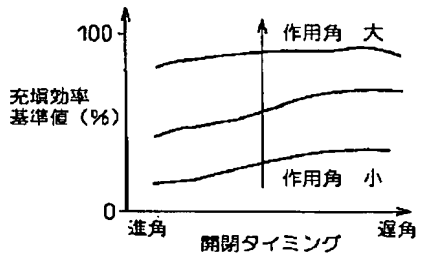

[Drawing 12]

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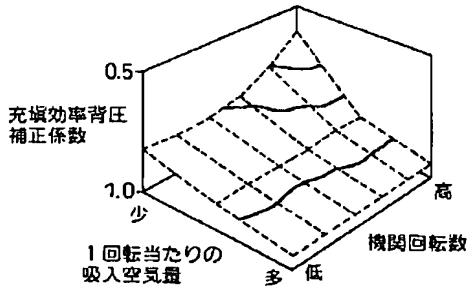

[Drawing 13]

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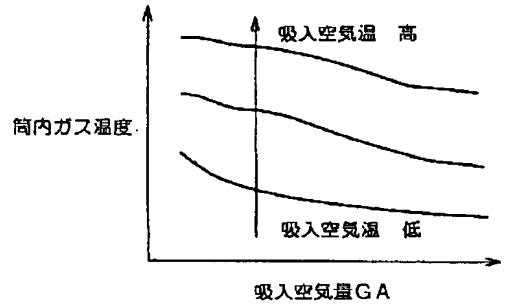
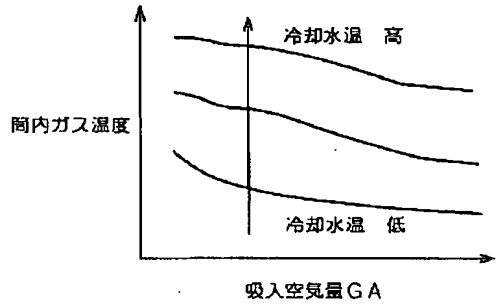


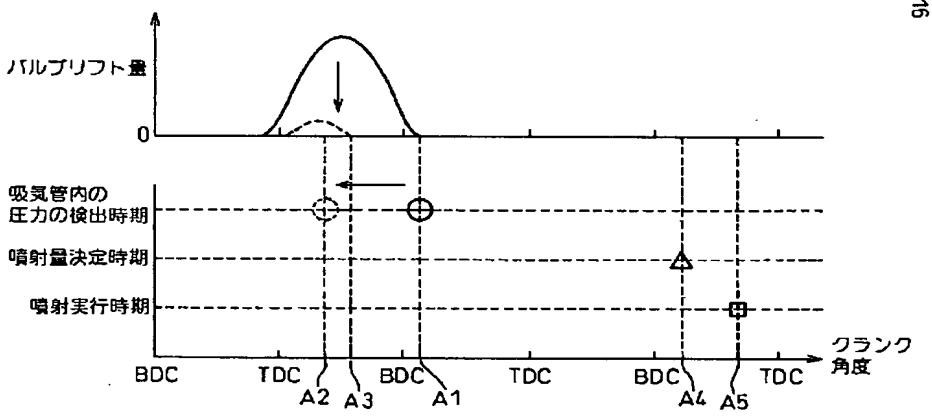
[Drawing 14]

図 14



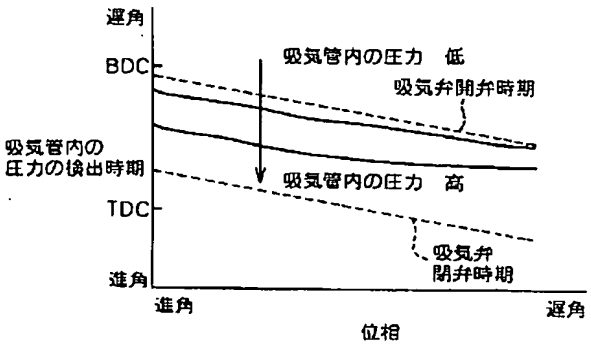
[Drawing 16]

図 16



[Drawing 17]

図 17



[Drawing 18]

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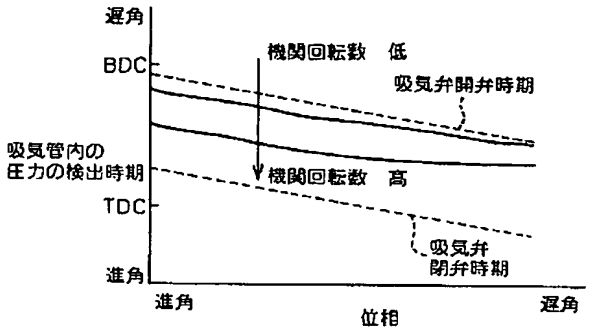

[Drawing 20]

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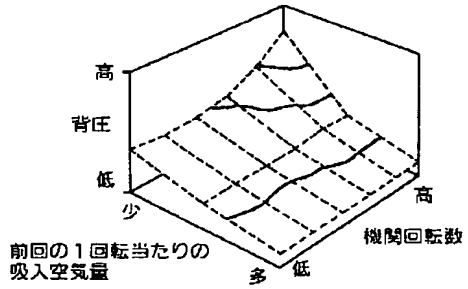

[Drawing 19]

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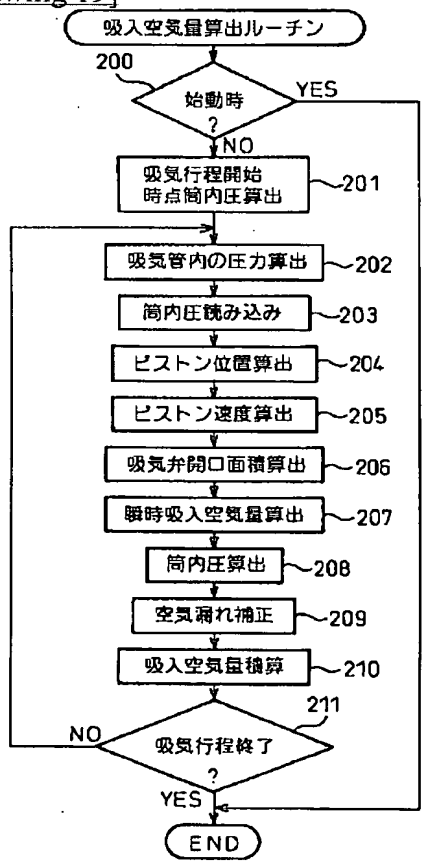
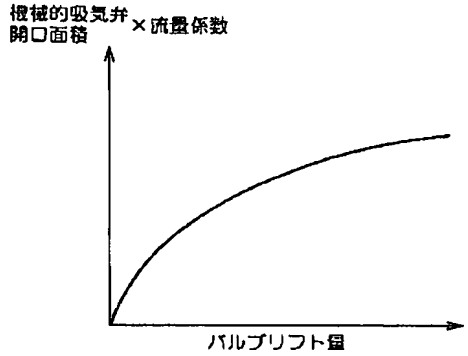


[Drawing 21]

図 21



[Drawing 22]

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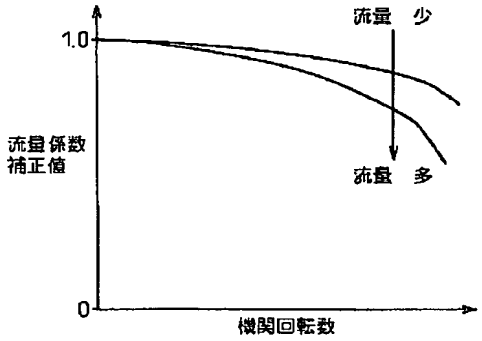

[Drawing 23]

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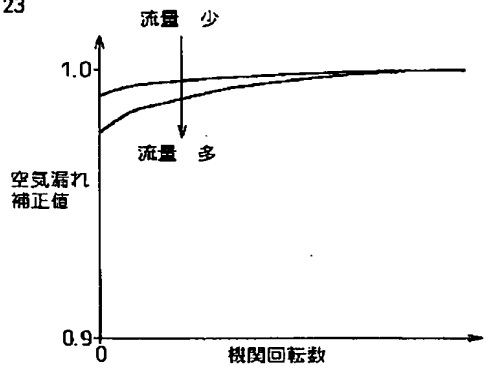

[Translation done.]

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CORRECTION OR AMENDMENT

[Kind of official gazette] Printing of amendment by the convention of 2 of Article 17 of Patent Law
[Section partition] The 1st partition of the 5th section
[Publication date] July 18, Heisei 15 (2003. 7.18)

[Publication No.] JP,2002-180892,A (P2002-180892A)
[Date of Publication] June 26, Heisei 14 (2002. 6.26)
[Annual volume number] Open patent official report 14-1809
[Application number] Application for patent 2000-377931 (P2000-377931)
[The 7th edition of International Patent Classification]

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F02D  45/00    366
F01L   1/34
13/00    301
F02D  13/02
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[FI]

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F02D  45/00    366 E
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[Procedure revision]
[Filing Date] April 16, Heisei 15 (2003. 4.16)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim
[Method of Amendment] Modification
[Proposed Amendment]
[Claim(s)]
[Claim 1] The inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the opening area of the inlet valve you are made to change by the good fluctuation valve system, the pressure within inhalation of air, and cylinder internal pressure in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content which possesses a good fluctuation valve system and is inhaled in a gas column.
[Claim 2] Cylinder internal pressure is the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by bringing forward the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air, so that it is presumed based on the pressure within [in predetermined timing] inhalation of air and the opening area of an inlet valve is made to decrease by the good fluctuation valve system.
[Claim 3] The inhalation air content arithmetic unit of the internal combustion engine according to claim 2 characterized by making the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed.
[Claim 4] The inhalation air content arithmetic unit of the internal combustion engine according to claim 1

characterized by computing the opening area of an inlet valve with a predetermined time interval during an inhalation-of-air valve-opening valve period, and computing an inhalation air content based on the opening area of the inlet valve for every predetermined time interval of the.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0007
[Method of Amendment] Modification
[Proposed Amendment]
[0007]
[Means for Solving the Problem] According to invention according to claim 1, a good fluctuation valve system is provided and the inhalation air content arithmetic unit of the internal combustion engine characterized by computing an inhalation air content based on the opening area of the inlet valve you are made to change by the good fluctuation valve system, the pressure within inhalation of air, and cylinder internal pressure is offered in the inhalation air content arithmetic unit of the internal combustion engine which computed the inhalation air content inhaled in a gas column.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0008
[Method of Amendment] Modification
[Proposed Amendment]
[0008] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 1 Since an inhalation air content is computed also based on the pressure and cylinder internal pressure within inhalation of air in addition to the opening area of the inlet valve you are made to change by the good fluctuation valve system, For example, even if it is the case where the opening area of an inlet valve is made to change by preparing the function to change the amount of valve lifts into a good fluctuation valve system, and changing the amount of valve lifts Compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without being able to compute correctly the inhalation air content inhaled in a gas column, and taking into consideration the pressure and cylinder internal pressure within inhalation of air.
[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0009
[Method of Amendment] Deletion
[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0010
[Method of Amendment] Deletion
[Procedure amendment 6]
[Document to be Amended] Specification
[Item(s) to be Amended] 0011
[Method of Amendment] Deletion
[Procedure amendment 7]
[Document to be Amended] Specification
[Item(s) to be Amended] 0012
[Method of Amendment] Deletion
[Procedure amendment 8]
[Document to be Amended] Specification
[Item(s) to be Amended] 0013
[Method of Amendment] Modification
[Proposed Amendment]
[0013] According to invention according to claim 2, the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by bringing forward the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air is offered, so that cylinder internal pressure is presumed based on the pressure within [in predetermined timing] inhalation of air and the opening area of an inlet valve is made to decrease by the good fluctuation valve system.

[Procedure amendment 9]
[Document to be Amended] Specification
[Item(s) to be Amended] 0014
[Method of Amendment] Modification
[Proposed Amendment]
[0014] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 2 An example is taken by the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becoming large as the opening area of an inlet valve is made to decrease. When presuming cylinder internal pressure based on the pressure within [in predetermined timing] inhalation of air The detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air is brought forward, and an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within inhalation of air, so that the opening area of an inlet valve is made to decrease by the good fluctuation valve system. Therefore, the pressure within inhalation of air can be uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the opening area of an inlet valve is made to decrease, and the inhalation air content inhaled in a gas column can be correctly computed compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air.
[Procedure amendment 10]
[Document to be Amended] Specification
[Item(s) to be Amended] 0015
[Method of Amendment] Modification
[Proposed Amendment]
[0015] According to invention according to claim 3, the inhalation air content arithmetic unit of the internal combustion engine according to claim 2 characterized by making the detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed is offered.
[Procedure amendment 11]
[Document to be Amended] Specification
[Item(s) to be Amended] 0016
[Method of Amendment] Modification
[Proposed Amendment]
[0016] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 3 If at least one of the working angle of an inlet valve and the phase of an inlet valve, i.e., the rotation phase of the cam shaft for an inlet-valve drive to a crankshaft, the pressure within inhalation of air, and engine rotational frequencies is changed An example is taken by the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changing with the modification. The detection timing of the pressure within [which is used in order to presume cylinder internal pressure] inhalation of air is made to change according to at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies being changed. Therefore, if at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changes with the modification, the inhalation air content inhaled in a gas column is correctly computable.
[Procedure amendment 12]
[Document to be Amended] Specification
[Item(s) to be Amended] 0017
[Method of Amendment] Deletion
[Procedure amendment 13]
[Document to be Amended] Specification
[Item(s) to be Amended] 0018
[Method of Amendment] Deletion
[Procedure amendment 14]
[Document to be Amended] Specification

[Item(s) to be Amended] 0019
[Method of Amendment] Modification
[Proposed Amendment]
[0019] According to invention according to claim 4, the inhalation air content arithmetic unit of the internal combustion engine according to claim 1 characterized by computing the opening area of the inlet valve you are made to change by the good fluctuation valve system with a predetermined time interval during an inhalation-of-air valve-opening valve period, and computing an inhalation air content based on the opening area of the inlet valve for every predetermined time interval of the is offered.
[Procedure amendment 15]
[Document to be Amended] Specification
[Item(s) to be Amended] 0020
[Method of Amendment] Modification
[Proposed Amendment]
[0020] In the inhalation air content arithmetic unit of an internal combustion engine according to claim 4, in view of the inhalation air content inhaled by per unit time amount in a gas column changing, the opening area of the inlet valve you are made to change by the good fluctuation valve system is computed with a predetermined time interval during an inhalation-of-air valve-opening valve period, and an inhalation air content is computed based on the opening area of the inlet valve for every predetermined time interval of the. Therefore, compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without taking into consideration that the inhalation air content inhaled by per unit time amount in a gas column is changing.
[Procedure amendment 16]
[Document to be Amended] Specification
[Item(s) to be Amended] 0057
[Method of Amendment] Modification
[Proposed Amendment]
[0057]
[Effect of the Invention] Even if it is the case where the opening area of an inlet valve is made to change by preparing the function to change the amount of valve lifts into a good fluctuation valve system, for example, and changing the amount of valve lifts according to invention according to claim 1 Compared with the case where an inhalation air content is computed, the inhalation air content inhaled in a gas column can be computed correctly, without being able to compute correctly the inhalation air content inhaled in a gas column, and taking into consideration the pressure and cylinder internal pressure within inhalation of air.
[Procedure amendment 17]
[Document to be Amended] Specification
[Item(s) to be Amended] 0058
[Method of Amendment] Deletion
[Procedure amendment 18]
[Document to be Amended] Specification
[Item(s) to be Amended] 0059
[Method of Amendment] Deletion
[Procedure amendment 19]
[Document to be Amended] Specification
[Item(s) to be Amended] 0060
[Method of Amendment] Modification
[Proposed Amendment]
[0060] According to invention according to claim 2, the pressure within inhalation of air is uniformly detected to predetermined timing, without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure becomes large as the opening area of an inlet valve is made to decrease. Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed from the pressure within [the] inhalation of air, the inhalation air content inhaled in a gas column is correctly computable.
[Procedure amendment 20]
[Document to be Amended] Specification
[Item(s) to be Amended] 0061
[Method of Amendment] Modification

[Proposed Amendment]
[0061] If at least one of the working angle of an inlet valve, the phase of an inlet valve, the pressure within inhalation of air, and engine rotational frequencies is changed according to invention according to claim 3 Compared with the case where an inhalation air content is computed based on the cylinder internal pressure presumed without taking into consideration that the difference of the pressure within [actual] inhalation of air and actual cylinder internal pressure changes with the modification, the inhalation air content inhaled in a gas column is correctly computable.
[Procedure amendment 21]
[Document to be Amended] Specification
[Item(s) to be Amended] 0062
[Method of Amendment] Deletion
[Procedure amendment 22]
[Document to be Amended] Specification
[Item(s) to be Amended] 0063
[Method of Amendment] Modification
[Proposed Amendment]
[0063] Even if according to invention according to claim 4 it can compute correctly the inhalation air content inhaled in a gas column compared with the case where an inhalation air content is computed and an operation of an inlet valve is changed by the good fluctuation valve system, without taking into consideration that the inhalation air content inhaled by per unit time amount in a gas column is changing, the inhalation air content inhaled in a gas column is correctly computable.

[Translation done.]